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No. 95

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FIRST FRENCH MACHINE FOR ETCHING INTEGRATED CIRCUITS

Paris ELECTRONIQUE INDUSTRIELLE in French 15 Jan 82 p 23

[Article by PI]

[Text] Designed and built by the Vacuum and Mechanics Division of CIT-Alcatel, with the support of the Ministry of PTT (Mail, Telephone, and Telegraph), and with the collaboration of LETI (Electronics and Data Processing Technology Laboratory) (AEC), the GIR 2000 is the first European machine for etching very high density (VLSI and VHSI) integrated circuits.

The original feature of the GIR 2000 is that it can handle two slices of silicon, one by one, in two reactors located one behind the other in the path of the slices; two etching processes can be used in the same enclosure: a purely chemical one for reactive plasma etching (GPR), and a physicochemical one for reactive ion etching (GIR). The etching operation can thus be performed in two stages, like conventional mechanical machining: rapid and anisotropic machining (perpendicular to the etched surface), followed by fine and selective finishing (immediate cessation of the substrate attack at the end of the etch).

These two operations can be performed by using either one of the etching modes, GPR or GIR. The GIR mode produces a physicochemical etch quite perpendicular to the etched surface, a necessary condition for submicron etching. The GPR mode produces a finishing etch (very selective chemically and without risk of damage to the substrate). Each of these operations can be carried out in an independent reactor, using different etching gases if necessary.

The etching operation is controlled by a laser system which determines the thickness of the layer to be etched after introduction into the first reactor, and then measures the etching rate during the plasma attack, this latter value characterizing the quality of the etched layer and thus the performance of the circuit. And lastly, the laser determines the overetching time (deliberate extension of the etching process so as to perfect the finishing). The non-uniformity of the slice is less than 3 percent. The laser could prove to have a double use: research is currently being carried out to use laser interferometry to control the quality of etched circuits.

The machine is loaded and unloaded by means of a cassette slice-distributor for 20 slices of 3-5 inches. The machine is fully automatic, controlled by a 6809 microprocessor (EFCIS), with incorporated parameter storage and display. Production rates are between 30 and 60 slices per hour, depending on etching conditions.

CIT-Alcatel has current sales of 14 MF in thin-film machines (vacuum deposition or sputtering and etching); this figure should grow to 22 or 25 MF in 1982, and reach 60 to 70 MF toward 1985, essentially thanks to etching. In order to achieve this growth, the division will move into a new specialized plant of 2500 square meters at Annency, devoted to thin film machines. This plant will be capable of producing 10-15 machines per month begining in 1983. And finally, the company is now working on a batch machine with automatic loading, capable of treating 150 slices per hour; this machine should be available in 1983.

Strategic Interest

Presently entirely dominated by the United States and Japan, the market for dry etching equipment is of obvious strategic and economic interest. It is indeed estimated that the world market, which was 90 million dollars in 1980, should grow to 335 million in 1984, with the growth rate for Europe and the West alone being predicted to be about 57 percent per year in value.

PHOTO CAPTION

1. p 23. Developed by CIT-Alcatel, the GIR 2000 can handle 30-60 slices per hour, depending on conditions. Its operation is entirely automatic, controlled by a 6908 microprocessor, with integrated parameter storage and display.

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CSO: 3102/143

ELECTRONICS

THOMSON-EFCIS: CURRENT, FUTURE PRODUCTION OF PROM'S

Paris ELECTRONIQUE ACTUALITES in French 15 Jan 82 p 15

[Article by J. P. Della Musia: "Samples of the First Thomson-EFCIS 16K PROM"]

[Text] The first samples of a Thomson-EFCIS 16K PROM having been well received by a few selected users, the Integrated Circuit Division (DCI) of Thomson-CSF is now in a position to move to large scale sampling (under the Thomson-EFCIS brand) for all interested users. This model, referenced as SFC 71 190/1, is a 2KX8 PROM, second source for the standard model introduced by Signetics. It uses an advanced TTL-LS technology of the emitter-follower type, and offers an access time of 35 ns. The chip area is 25 mm-square; the finest lines on the fusible-links do not exceed 1.5 microns, which represents a low performance for a mass product.

An Offensive for Digital Bipolars

This digital bipolar circuit is a "vehicle" logic circuit, representative of the 1980 state of the art, which allows Thomson-EFCIS to gain a new foothold in high performance digital bipolar technology. Bipolar technology with fusible-links was already used five years ago by Sescosem, which had an off-the-shelf 4K model with nichrome technology. But the company was undergoing serious losses at that time, and production had to be curtailed. Development efforts were therefore concentrated on analog circuits. At the beginning of 1980 however, delivery lead times for PROM's on the world market exceeded one year. The financial situation of the division having improved, the decision was reached to reinvest in this domain by producing a 16K model with an almost conventional technology, at least at first (compared to Sescosem's old PROM's, the fusible-links, which are only 1.5 microns wide, are of titanium-tungsten rather than nichrome, the epitaxy is thinner at less than 3 microns, the emitters are diffused through the polycrystalline material, and the process involves ion implantation). Since the market will remain strong for a long time (the speed of these memories is needed in many applications), commercial risks are low, manufacturers are few in numbers, and the world market amounts to 400 million dollars. This offensive had the advantage not only of involving the division in an interesting area, but also introducing processes for rapid digital bipolar technologies, which could be used as springboards for the production of other bipolar circuits that are in great demand, such as microprocessors, multipliers, converters, and eventually TTL's programmable by fusible-links. Since then, and as part of the integrated circuit plan, prototypes of 4K PROM memories with lateral oxide insulation, have been built in order to perfect an Isoplanar type process (no decision has been reached about the eventual commercialization of this memory). It can be expected that this technology will be used for the company's future advanced circuits, if only because the rules for reducing circuit dimensions apply readily to Isoplanar type circuits (a library of precharacterized circuits in this technology should already have been installed).

Two Other Version in Preparation

The 16K PROM being sold today and which should enter into mass production within two months, will soon be followed (before June) by a smaller geometry version, with an area of 18 mm-square and an access time of 30 ns. The next version, which should be market sampled at the end of 1982, will be smaller yet: only 14.5 mm-square, and perhaps even less. An access time of 25 ns is being aimed at. It is possible for this version to be the first at DCI to commercially use an Isoplanar technology which it calls EPILOX 1. The 32K and 64K versions to follow, will make use of the same technology.

But the second technologic generation of lateral oxide insulation, EPILOX II, is being developed at the St-Egreve plant. This is a generation equivalent to Isoplanar II, but with thicker epitaxy (1.2 microns) and with two self-alignment sequences, partly in order to obtain better fabrication yields. Polycrystalline technologies are also being involved in order to reduce consumption and chip areas. This technology, which will allow transition frequencies of 6 GHz, similar to those of transistors, should be used industrially in 1985. Other improvements will then be possible by using two levels of polycrystalline silicon and an non-saturated internal logic. Thus, starting with an advanced TTL with a figure of merit of 3 ns/8 pJ, self-alignment makes it possible to reach 1.5 ns/4 pJ, and the use of one level of polycrystalline silicon 1.5 ns/0.8 pJ. With two polycrystalline levels and a non-saturated logic, it will be finally possible to achieve 0.3 ns/0.18 pJ. But this is still far from industrial production.

11,023
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FRENCH COMPANIES ATTAIN OBJECTIVES OF VLSI PLAN

Paris ELECTRONIQUE ACTUALITES in French 22 Jan 82 p 12

[Article by JPDM: "EFCIS and DCI Achieve Their VLSI Plan Objectives"]

[Text] The French integrated circuit plan, which will end in 1982, included a research and development section called the VLSI plan, which ended in 1981.

And while as part of the VLSI plan, Eurotechnique and MHS obtained large loans and subventions to acquire technologies and invest in equipment, EFCIS and the Integrated Circuits Division (DCI) of Thomson-CSF have had the benefit of study contracts to develop technologic processes and products in order to achieve technical independence. A large portion of these actions is therefore part of the VLSI plan.

Within this plan, EFCIS and DCI have achieved most of their stated objectives. At the end of 1981, the first results have been EFCIS's attempts to distribute the 68000 microprocessor with a proprietary H-MOS 2 technology with 2 micron lines, and DCI's market sampling of its first 16K PROM's.

We might recall that as part of the integrated circuit plan, EFCIS received an aid of 190 MF, tax-free, for process studies and development, and DCI 100 MF, also tax-free; the contracts signed by them implied that equivalent investments had been made by the respective industrial enterprises.

Between 1978 and 1981, EFCIS will have invested along with these sums 250 MF of its own funds, and DCI 150 MF, solely for industrialization.

The Means for Independence

As part of the integrated circuits plan, EFCIS and DCI (Thomson-EFCIS brand) have especially sought to achieve independence, either the level of technologies, circuits, or commercialization (outside of the plan).

In 1978, EFCIS's processes were not sufficiently strong to attack the world market. That is why the company, in order to develop sales, bought with its own funds the N-MOS and H-MOS 1 (3 micron) processes from Motorola, in collaboration with LETI, LCR, and CAMECA, so as to become technologically independent for advanced circuits 2 micron lines (H-MOS2) and more (H-MOS 3 to 5).

These studies, now ended for H-MOS 2, have already affected H-MOS 1 circuits, whose yields have been improved through plasma etching, as well as C-MOS devices, which currently involve more than half of EFCIS's circuit production. They will also make it possible to envisage the production of advanced circuits by combining H-MOS and C-MOS technologies on the same chip.

If EFCIS/DCI entered into the advanced technology race, it was not in order to become a technologic leader and produce circuits more complex than those on the market, but simply in order to improve the production yield of existing or future circuits, and in order to increase the speed of these circuits in general. In short, it was a matter of providing all the material chances for circuits which must become increasingly innovative in their integration.

As part of the agreement signed with the government, 50 percent of the credit allocated to EFCIS, and 20 percent of that allocated to DCI, was assigned to the VLSI effort. The remainder was and is devoted to the development of production lines (processes) as well as product lines.

Progress Still Necessary on Materials

In the EFCIS VLSI program, all the objectives have been practically attained, with slower progress having been noted on the material silicon.

As part of its materials research, EFCIS has studied the influence of oxygen and carbon in bulk silicon, and has compared the substrates of various suppliers in this respect. It proved difficult to obtain the materials specified. The company has also investigated the deformation of 3 and 4-inch substrates, and demonstrated the important role that could be played by treatment temperature reductions in this respect. And finally, EFCIS has used test circuits to study epitaxial deposits on substrates.

All the objectives in masking research have been reached. In particular, the aim was to use wafer stepping for the H-MOS 2 and HC-MOS technology; EFCIS is now effectively capable of reproducing 2 micron plus/minus 0.2 micron lines on 4-inch slices with production equipment.

Several objectives were defined for etching. Apply plasma etching to H-MOS 2 technology: that is now an accomplished fact. Etch silicides: that has been accomplished (but the anisotropy is still insufficient). And finally, improve dimension control at critical stages: better anisotropy has been obtained thanks to reactive ionic etching.

In the CAD and modelling field, all objectives have been met. Models, as well as analog models, have been perfected for circuits up to H-MOS 3. Multi-level (graphic, symbolic, electric, and technologic) data bases have been established. And finally, parametrable macrocomponents have been defined.

H-MOS 2 Beginning Production in Mid-1982

These VLSI studies have already had an industrial fallout. Plasma etching on silicon nitride and polycrystalline silicon is used in the fabrication of H-MOS 1 (which have been in production since the beginning of 1981) and of C-MOS circuits.

Wafer stepping (10/1), plasma etching, and the use of silicides, will be exploited industrially on H-MOS 2 circuits beginning in mid-1982 for market sampling (mass production in 1983). Feasibility for H-MOS 3 (1.2 micron patterns) has now been demonstrated, thanks to optical solutions for lithography and to reactive ion etching.

A 16K PROM Sampled

Thomson-EFCIS does not yet want to disclose all the important results obtained in the bipolar field. However, it is as part of the VLSI plan that it was possible to develop 1.5 micron fusible-links and a process named EPILOX 1 (lateral oxide insulation on epitaxial layer) for digital circuits, which make it possible to build an experimental 4K PROM, and then in part, a 16K PROM which is being market sampled today. A process called EPILXOX 2 is being tested, with the aim of providing Thomson-EFCIS with a technology for lateral oxide insulation (improved Isoplanar type) for 2 micron lines and thin epitaxy.

EFCIS Service in Tokyo

As we have said, EFCIS and DCI have sought since 1978 to become independent, not only technologically, but also for circuits and commercial services. That is why, relying on the Thomson-CSF export network, Thomson-EFCIS has entered the international market to sell standard products, as well as to discover tomorrow's leading products. Thomson-EFCIS thus has marketing representatives in Germany, Italy, the Far-East, and soon in the United States. In the Far-East, Thomson-EFCIS is located in Singapore, where one million circuits are assembled each month, and in Hong Kong, where it has a testing group, marketing and commercial services, and an assembly activity for certain products. EFCIS has also hired its first employees in Tokyo four months ago.

11,023
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ENERGY

FRENCH PROJECTS FOR UNDERGROUND GASIFICATION OF COAL

Paris SEMAINE DE L'ENERGIE in French 12 Jan 82 pp 15-16

[Text] Within its program of research and development of coal utilization technologies, Charbonnages de France is pursuing experiments in deep underground gasification techniques.

The French underground gasification project aims at gasification of deep coals inaccessible for development by traditional mining methods. According to an initial estimate, coal reserves thus recoverable could be evaluated at 2 billion tons. Only understanding of all technical criteria of the process, however, can permit their precise determination.

Techniques to be applied relate to widely diversified fields, so Charbonnages de France, Gaz de France, IFP [French Petroleum Institute], and BRGM [expansion unknown] have joined their expertise to form the GEGS [Underground Gasification Study Group]. Its aim is to bring into use, in time, an industrial process for production of a synthetic natural gas by surface conversion of primary gas obtained by underground gasification of coal into methane. The process consists of successive steps:

Drilling of two bore holes a few dozen meters apart;
Creating a passage between the two bore holes;
Achieving enlargement and permanence of the passage by retrocombustion (progression of combustion in a direction opposite that of the air current);
Attaining complete combustion of the vein by injection of a gasifying agent into one of the bore holes;
Recovery of gases thus produced in the other bore hole.

Concurrently with laboratory studies conducted at the CERCHAR [Coal Mining Study and Research Center], field experiments were performed at Bruay-en-Artois (Pas de Calais), and are in progress at L'Echaux (Loire) and La Haute Deule (Pas de Calais).

The Bruay-en-Artois Experiment

The aim of the first in situ experiments conducted in 1979 and 1980 at site no 6, Bruay-en-Artois (Nord Basin and Pas-de-Calais Collieries) consisted of opening a passage between two bore holes. From a mine gallery 1,000 m deep, two bore holes 65 m apart were drilled to reach a coal vein 1.20 m thick located 170 m deeper. The method chosen consisted of two stages:

Pre-connection by hydraulic fracturation to provide minimal connection between bore holes;
Enlargement of, and attainment of permanence in the connection by retrocombustion.

Successful pre-connection by fracturation, which is a world first, led GEGS to start, in July 1980, the first experiment in lighting and retrocombustion at great depth.

That experiment gave encouraging results and provided much data, particularly concerning problems of oxygen absorption by coal and of self-lighting, which will be taken into account in the new experiment to be started at the Haute Deule site.

The Echaux Experiment

Another series of experiments is in progress at L'Echaux in the Loire Collieries, in a coal vein of shallow depth (30 m). On this site are performed tests of connection by electrocarbonization and of chemical lighting, and attempts are made to improve coal permeability by chemical attack.

The Haute-Deule Experiment

In the next few days a comprehensive experiment on the principle of underground gasification will begin at the Haute-Deule site near Pont-a-Vendin in Pas-de-Calais.

Two zones will serve as the experimental site on both sides of the Haute-Deule canal. In each will be drilled an initial bore hole for the necessary reconnaissance. Then, in one of them, the Bruay-en-Artois experiment will be repeated, but this time from the surface, to reach a vein 1,000 to 1,200 m deep consisting of a different type of coal. In the other zone will be established the demonstration pilot which will permit the experiment to be carried to the point of coal combustion, with recovery of gases for interpretation and analysis.

6145
CSO: 3102/134

COAL GASIFICATION ON THRESHOLD OF BEING ECONOMICAL

Duesseldorf EUROPA CHEMIE in German No 35/36, 1981 p 637

[Article subtitle: "Uhde's Symposium on Coal Refining: Demonstration Plant at Wesseling"]

[Text] Coal gasification has not in general achieved the leap necessary to become an economical process; however, there definitely are examples where this threshold is being reached, if not surpassed. This was said to Dutch experts by Dr Hermann Weber, managing director of Uhde GmbH, Dortmund. Such examples would be the plants of Sasol Ltd in the Republic of South Africa, for which security of supply as well as economy was the reason for initiating construction, and the project of Rheinische Braunkohlenwerke AG [Rhine Brown Coal Works, Inc].

Today Uhde offers a number of processes which in part were developed with other partners. At Uhde, Texaco coal gasification is judged to be a good possibility. This process has both cost and environmental advantages because, at the elevated gasification temperature in entrained flow, byproducts are not formed which would require expensive technical equipment for wastewater treatment. The high-temperature Winkler process is intended for gasification of brown coal. A pilot plant operated since 1978 (30 metric tons per day) confirms it to be economical. Rheinbraun therefore plans to construct a large-scale plant for production of synthesis gas which will be able to supply a 1000 metric ton per day methanol plant. During the approval process, already completed, it was possible to prove that the authorities' requirements with respect to environmental protection was met fully. The request to do the detailed engineering was recently given to Uhde. The first train of the plant is supposed to go into operation in 1984.

Until now methanol has been produced mainly from natural gas. A changeover to coal as a raw material means that, apart from coal gasification, supplementary treatment steps and additional plants are required. Moreover, there are increased expenses for environmental protection. Investment costs for a methanol plant from coal are therefore more than twice as high as for a natural gas plant. This means that the capital cost component of the production cost becomes larger. Where coal is available at low cost, the production will be competitive.

Further subjects of the symposium were coal gasification for combined-cycle power stations and the Mobil process for conversion of methanol to gasoline. High-octane gasoline can be produced from methanol by dehydration over a zeolite catalyst. By application of fluidized bed technology, a very simple processing at high yield can be obtained. Inasmuch as the laboratory and small pilot plant tests have been successfully completed, a demonstration plant with a capacity of 20 metric tons per day is now being constructed at Wesseling near Cologne by the partners Mobil Research & Development Corporation, Union Rheinische Braunkohle Kraftstoff AG [Union Rhine Brown Coal Fuel, Inc] and Uhde. The plant will go into operation in 1983.

5586
CSO: 3102/137

'CIRCULATING FLUIDIZED-BED' COMBUSTION LOWERS ALUMINUM COST

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 18 Dec 81 p 7

[Article: "Coal Utilization without Polluting the Environment; A New Energy Concept from Lurgi"]

[Text] L.P. Frankfurt, 17 December--A new process to replace oil and gas with environmentally benign combustion of even low-quality domestic coal and thus to reduce the energy cost of aluminum production considerably has been proposed by the Vereinigte Aluminum Werft AG [United Aluminum Shipyard, Inc] (VAW). Coal combustion is carried out by means of a "circulating fluidized-bed" process developed by Lurgi Chemie and Huettentechnik [Lurgi Chemistry & Iron and Steel Technology], Frankfurt, and VAW. A demonstration plant with a thermal capacity of 75 megawatts is under construction at VAW. After it is put into operation in mid-1982, it will be the largest plant of its kind. The project is supported with government money. The characteristics of the new process are:

--Fuels of various qualities can be used, including high-ash and high-sulfur coals.
--A very high degree of coal combustion is achieved, and thus the fuels are almost completely utilized.
--Environmental pollution is kept very low. High degrees of desulfurization of over 80 percent have already been achieved through the addition of relatively small amounts of limestone. Emission of highly poisonous nitrogen oxide in the flue gas is avoided to a very large extent by the low combustion temperatures and by a two-step combustion process characteristic of the circulating fluidized bed.
--The firing system has good partial- and low-load operating characteristics, and single units of up to 300 megawatts electric are achievable in the future.

Large-Scale Technical Experience

The new process does not rely primarily on development on the laboratory or small pilot plant scale. Fluidized bed technology has been applied on an industrial scale by Lurgi for almost 30 years for the various processes of the chemical industry, with great success. This includes more than 200 plants with so-called stationary fluid beds for the roasting of sulfide ores at 800 to 1000° Celsius, followed by sulfuric acid production in which, as required by the process, waste heat boilers for cooling the gases by generation of steam are needed. The so-called "circulating fluidized bed," which also is a joint Lurgi-VAW development, is today the standard process for drying (calcination) of wet aluminum hydroxide at temperatures of over 1000° Celsius, in the course of aluminum production. Twenty-four plants under construction or in operation since 1970 represent about 40 percent of the world capacity of aluminum oxide production today. The success of the process is considerable because of the fact that up to 30 percent energy in the form of oil or gas can be saved in comparison with processes used up to now. A new process has been developed on the basis of proven components by specific research and development which is now to be demonstrated on an industrial scale at Luenen.

Energy Costs Considerably Reduced

Technically the new process consists essentially of coal preparation, the fluidized-bed combustion unit, a boiler for the production of steam from flue gases at 850° Celsius and a heat exchanger for heating the molten salt. The molten salt serves as the high-temperature heat carrier in a processing step of aluminum oxide production. Up to now, the molten salt had to be heated in oil- or gas-fired separate combustion chambers. Grate-fired installations in which only high-quality and thus expensive nut coal could be fired were used up to now for the steam generation of the factory.

The new firing installation substitutes a low-quality fuel, in this case ballast coal with up to 60 percent ash, for oil and gas as well as high-quality coal. Energy costs of the factory can be reduced considerably by operation of the new plant, and the energy supply can be assured long-term from domestic sources. Despite these successes, the fuels oil and gas cannot be replaced in all production steps. In particular, the highly energy-intensive step of calcination of the aluminum hydroxide in the circulating fluidized bed requires oil or gas as a clean fuel because contamination would lead to unacceptable contamination of the product. Direct substitution through the combustion of coal is therefore not possible. Here, the next processing step has already been proposed; it leads to complete substitution for oil or gas and thus the supply of the industrial enterprise with a complete range of all forms of energy--gas, electric current, steam, high-temperature heat (molten salt)--on the basis of a single raw material, i.e., low-quality domestic coal.

Partial Supply of Coal

A coal gasification plant is introduced ahead of the coal combustion plant to be installed. The coal gasification plant operates at atmospheric pressure and also following the principle of the circulating fluidized bed, and is designed very simply. The fuel gas produced by the addition of steam and oxygen has a heating value sufficient for operation of the existing calcination installations and other smaller users. Coal is only partially combusted. The unreactive components still containing a large amount of carbon do not, however, constitute a loss in the overall process because they are introduced directly into the fluidized bed combustion installation and are there burned with essentially complete utilization of their residual energy content. Additional emissions do not arise through operation of the gasification plant because the leftovers from fuel gas purification can also be rendered environmentally harmless by means of combustion. The requirement to use the most varied--and also very unconventional--fuels for energy production with regard to present-day environmental standards, high energy conversion efficiency and flexibility in the choice of fuel makes a test of the fuels on an essentially industrial scale absolutely necessary.

5586
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ENERGY

BRIEFS

GASIFICATION PROJECT NEWS--(1) In France Charbonnages de France, with GEGS /Underground Gasification Study Group/ is perfecting at Vendin-le-Vieil the sequel to in situ gasification experiments conducted in 1980-81 at Bruay-en-Artois. The program is in process of setting up and should be further defined in coming weeks. It will be operational early next year. The first step will repeat the experiment performed at Bruay in a deep gas producer, but will start this time from the surface rather than from a pre-existing gallery. Operations will thus focus on fracturing*, retrocombustion*, and surface recuperation of gas produced. The stage of methanization (transformation of the gas to methane) on the surface is not planned in the project. (2) The board of directors of Gaz de France has decided to build a coal gasification plant at Le Havre. Capacity, 1,000 tons of coal per day for 300 million cubic m per year; cost, Fr 550 million; building time, 5 years. (3) For Mcbil and Ruhrkohl in West Germany, the Fluor firm is studying the technical and ecological feasibility of a plant to utilize three processes, the first to produce gas exclusively, the other two to produce gas and motor fuel. (4) In Belgium, the underground gasification experiment envisaged at Saint Ghislain will be delayed in its planning. Lighting to connect bore holes will not be done until December, or tests until the spring of 1982. /Text/ /Paris SCOOP ENERGIE in French 15 Dec 81 p 10/ 6145

NATIONAL SYMPOSIUM ON RESEARCH, TECHNOLOGY LAUNCHED

Paris AFP SCIENCES in French 14 Jan 82 pp 1-8

[Report on national symposium on research and technology: "Policy and Organization of Scientific Research," held in Paris on 14-16 January 1982]

[Text] Paris -- Mr Mitterrand: Research, "key to renewal" to get us out of the crisis. On opening the national symposium on research and technology, President Francois Mitterrand forcefully emphasized the essential role which research must play as a means to get out of the crisis and as a tool for the future.

"We must get out of the crisis, and research represents one of the keys, perhaps the key, to renewal," emphasized the head of state. "A gigantic research effort alone will allow France to find a place among the few rare nations which are capable of controlling their technology and, in the final analysis, to preserve their independence."

"The struggle will be hard," noted Mr Mitterrand. "We have to start with an act of will, and accept as inescapable neither the economic reports of domination, nor the international division of labor as it is today."

Stressing that the symposium represents "the first and most vivid manifestation of this will," Mr Mitterrand added: "Everyone is well aware that this is a political stake in the noblest sense of the word, because all of us together must invent new relationships between man and science."

Expressing his faith in science, "a science at the service of man, but not the reverse," the president of the Republic brought out "the very strong support" of all those who believe in the future development of research and technology, "a major ambition of our policy." "If we want to govern our future and not become its toy, we will have to resolutely and clearly exploit our principal wealth: that reserve of dynamism, of movement and of independence which makes up a highly motivated and high quality scientific community."

Next, Mr Mitterrand recalled the measures which have already been taken, such as the establishment of a large Ministry of Research responsible for this mission of being "an advocate for the future," the budgetary commitments through which the civilian research budgets will increase by 25 percent as of 1982, the decision to increase research spending up to 2.5 percent of the gross domestic product in 1985, and so forth... He recalled that the vast national debate, illustrated by the symposium, would lead to the orientation and planning act which Mr Jean-Pierre

Chevenement will propose to the government, and which will be submitted to parliament next spring.

This law, specified the president of the Republic, will program the large masses of financial effort for research for the coming years and will provide this activity with the framework it needs: it will establish the role and social function of the research professions, it will renew and expand the means for the formation of the scientific and technological professions, and it will adapt the national and regional organization to the requirements of decentralization.

"I would like to see it very deeply inspired by the desire, which this symposium bears witness to, to place research where it should be placed today; not in an isolation which would confine the researchers to their centers and laboratories, but at the crossroads of all the big problems of our society."

"Because, if the creativity of all those who participate in our scientific and technological development needs a large freedom to blossom, if creativity cannot be imposed, then it will be really prolific only in a symbiosis with the concerns and evolutions of the nation. Indeed, history has widely shown that the strong periods of evolution of our societies and our cultures most often coincide with the strong periods of scientific thought, and that in those periods the work of the researchers was influenced by the ideas and forces passing through society, as they themselves also influenced them."

Speaking about the necessary opening of the world of research to the outside, whether to society, the economy, foreign countries, the Third World, etcetera, the president of the Republic stated the following:

I. "Opening of the world of research to the economic world: a rich dialogue between researchers and their economic environment is an absolute necessity for the future of our research. Hence, we must increase the means for this dialogue, for cooperation between research and industry, and for the mobility of researchers."

"This way, the researcher will be able to participate more actively in the transfer of knowledge to the users and in its implementation in society."

II. "Opening also to our society in its democratic expression: here again a vital necessity has been neglected far too long. We want research and technology, their evolution and their consequences, to be better known by those who have to make decisions for the community, and we want researchers to explain their hopes and fears, and submit to political reflection the controversies which result from the evolution of knowledge. But we also want the researchers, the innovators, the technicians to be aware of the large objectives set by the country. Today, they must know in what direction we are working to get out of the crisis: to recapture the domestic market, to ensure employment, to reduce inequalities, to improve labor conditions, to create new relations with the developing countries, all of which are concerns which those whose mission it is to create the tools for the future must be familiar with."

"Among the means necessary for this dialogue between political officials and research, I have suggested the establishment of an office for the evaluation of technological choices, which would allow the elected officials to have those elements necessary for the making of important decisions, which involve the future of the country, at their disposal. It is now up to parliament to endow it."

"At the same time, the decentralization effort embarked upon by the country will lead to a greater participation of the regions in the important scientific and technological choices. Hence, these communication-procedures must also be developed at the regional level, and for each region according to its special situation. The state will respond to the obvious desire of the regions to participate in the large scientific and technological effort by associating them with the preparation of national choices and by helping regional actions which contribute to their realization."

"These developments are in keeping with the demand for democracy expressed by the country and which this symposium should debate extensively: it is indeed inseparable from the establishment of new relations between the world of research and technology and the political powers."

III. "Finally, opening to the outside world. It is very important that one of the themes of the symposium has been devoted to the international stake. For a long time, scientists and technologists have known to what extent the success of their work is expanded by exchanges with those who conduct parallel or complementary work everywhere in the world. They want extended and effective contacts, and they can be relied upon to develop them. They should know that it is our wish to support them on this road, and to make sure that structures and regulations do not hinder this."

"This concern for an international environment which conditions our evolution, and with regard to which we must define our action, must be present in the minds of researchers, industrialists, and politicians alike. There are plenty of questions when we think about this area. The government has already indicated the roads it intends to take. But we are far from having solved all the problems at the various levels at which they appear. I will touch on three of them:

1) The European level. We belong to a community of peoples who are close in terms of their culture and in terms of their responsibilities in the face of world problems. To these challenges, these responsibilities, they must attempt to provide a common response and to prepare the future together. It has been proven that a fruitful cooperation is possible: European achievements in the fields of aeronautic construction and of space show that Europe can be successfully present where the future is being prepared. This is why France has made proposals for a revival of European ambition, specifically in the area of research."

2) "The level of tough competition waged by the industrialized countries, old or new. Everyone is aware now that one of the main assets of this competition is innovation. Far from trying to protect ourselves from it, we should on the contrary mobilize our intellectual and industrial resources to play an active role in it. It will be an essential act of our technological development policy to contribute to it by relying on the role as a moving force assigned to the national enterprises and by furthering the sources of innovation which are so numerous in the small and medium sized enterprises. Do detect these innovations, see to it that they are supported and developed, and make sure that the large enterprises play their role of driving force in keeping with the national interest: these are actions which

the public authorities will have to take, and to which I am convinced that this symposium will be able to contribute valuable suggestions."

3) "Finally, the level of the Third World and of its necessary development. True, a goodly number of disappointments have marked these last decades. They should not lead us to despair, but rather to recognize that the efforts made to transfer development tools to those countries have lacked a basic requirement, that of adapting them to their cultural individuality. It is by trying to respond to the needs of these countries, by helping them express their demands, by being attentive to their search for a development adapted to their situation, that we will be able to contribute usefully to their development. At the same time, the intellectual riches of those countries, which have been smothered by a type of development imposed from the outside, may on the contrary become a contribution to the development of world science."

"France has a significant role to play in this effort to place science at the service of development. It makes it possible to link the most modern technological know-how with the cultural wealth of the Third World countries. New methods will have to be developed to join together research efforts, as we decided to do with India through the establishment of a common research center."

Speaking about the large mobilizing programs, the president of the Republic said: "I have asked the minister of state for scientific research and technology to study the launching of mobilizing programs. As a matter of fact, he has already, within this framework, put in place a certain number of missions, the conclusions of which I would like to have rapidly examined; other suggestions will come out of this symposium. Indeed, it seems to me necessary that initiatives be taken and long term actions be undertaken."

"This concerns first of all certain major areas, guarantors of the future, which France must learn to master for fear of losing its independence and its competitiveness. I would like to cite, as an example: electronics, certainly; computer science, which is considered important and which has led me to decide on the establishment of a world center for microcomputers in Paris; the rational use of energy, at the heart of our country's autonomy; and biotechnologies, which are present virtually everywhere."

"It will also be a question of getting the full measure of the major national aspirations: improvement of labor and employment conditions, improvement of public health, scientific and technological cooperation with developing countries, development of communications and diffusion of culture, and the promotion of French as scientific language."

"The launching of mobilizing programs will involve our basic industries, those which sustain our economic fabric and ensure employment. Indeed, the distinction between key sectors and traditional sectors is no longer very significant; henceforth, all activities will call on more and more advanced technologies, which are the condition of their survival and their development."

"I am thinking specifically of three branches in which research is immediately imperative: the construction of housing to give the French the life style they aspire to, the agricultural food industry which exploits an essential part of our national heritage, and finally the mechanical engineering industry which contributes to all industries."

"This list is neither intangible nor exhaustive; the work at the symposium will be able to specify its outline... knowing, however, that in becoming too long it would lose its meaning."

"I would like to tell you the particular value I place on seeing that biology be placed in a leading position in science and its applications. The study of life has been at the heart of human concerns since the most distant times, but its scientific blossoming has only come about during the last few decades, thanks to a renewal of ideas to which French researchers have widely contributed. This effort should be continued and expanded in order to enable the development of knowledge and the implementation of opportunities which offer great hopes, such as biotechnologies."

In conclusion, Mr Mitterrand stated: "In the future, France will be the great country its genius demands only if it is able to reconcile its entrepreneurs, its workers, its researchers, its administrators and its artists with a passionate search for a cultural project for the 21st century. Such is the unique ambition which should, if possible, make France a democracy in the 20th century. To ensure that science, in all its forms, serves a single goal for France and for the world: to expand freedom."

"Indeed, to reduce the suffering of mankind is to expand freedom, to improve the knowledge of the universe and of matter is to increase freedom, to bring about progress in chemistry, astronomy, physics, biology or even anthropology and linguistics is to increase freedom."

Earlier, Mr Jean-Pierre Chevenement, minister of research and technology, paid a vibrant tribute to the president of the Republic by recalling that, as of 22 April 1981, at the time of his press conference in Luxemburg, "he had given the impetus, and with such forcefulness" and assigned objectives "with such precision," to the development of research.

Mr Chevenement declared:

"Of the 10 main objectives you indicated, several have already through your impetus become a reality:

- To create a large Ministry of Research, which would bring together the means scattered and dispersed among several ministries? This has taken shape.
- To restore basic research, "the milk of life"? The program permits granted to the CNRS [National Center for Scientific Research], to the research mission of the universities, to INRA [National Institute for Applied Research] and to INSERM [National Institute for Health and Medical Research] have begun to ensure that we will catch up. This effort will be continued.
- To build mobilizing programs, to improve and rationalize the relationships between research and industry in order to regain the domestic market and preserve our independence?

It is a decisive part of the policy which is being developed.
- To cultivate the taste for research and to provide scientific information to the French people?
It is the task of the interministerial task force for the diffusion of scientific and technological information, which has been restructured and provided with increased resources.
- To establish new European programs, and put research in the service of new kinds of relationships with the Third World countries?
This has been started, even if the results are still modest.
- Finally and primarily, you wanted, Mr President, to break the isolation of research."

"The researcher, you said, must multiply his contacts with the citizens, with his colleagues and with other disciplines, with the worlds of education and of business. This is an absolute priority. It is up to us, up to you, to find the methods, the structures, the procedures which will make it possible to reach that objective."

"The vast repercussions of this symposium are the most obvious evidence of the fruitfulness of the indicated direction."

"The fact that in such a short period of time, so many obstacles were overcome, or are in the process of being overcome, is the mark of a change which the people have gradually come to believe in. And this may be the most moving thing -- in the real sense of the word -- about this symposium -- a modest undertaking at the start, for something which over the months became a vast intermingling of men and ideas, and which constitutes -- an unprecedented fact -- both in France and abroad, a real 'States General of research and technology.'"

Mr Francois Gros, president of the organizational committee for the symposium, who spoke at the inaugural session, concluded as follows: "Will these two last decades, marking the end of the millenium, have the moroseness of 'lost illusions,' or will they really coincide with the beginning of a new era for research and technology, culture and science, the beginning of a new alliance between the world of research and the vital forces of the nation?"

The symposium is to end on 16 January with a major speech by Prime Minister Pierre Mauroy, and an important speech by Mr Jean-Pierre Chevenement, who will explain the law on the planning and orientation of research and of technology.

During the afternoon of 15 January, numerous political and trade union personalities will take part in the plenary sessions of the symposium. Among them, Guy Hermier (PC [French Communist Party]), Lionel Jospin (PS [Socialist Party]), Michel Pinton (UDF [French Democratic Union]), Alain Devaquet (RPR [Rally for the Republic]), Micel Rolant (CFDT [French Democratic Confederation of Labor]), Rene Le Guern (CGT [General Confederation of Labor]), Robert Cottave (CGT-FO [Workers Force]), M. Fillon (national union of PMI /Small and Medium Industries/).

It will be recalled that more than 40,000 people participated in the 31 regional conferences of science and technology. Half of them came from the public research sector, 20 percent from industrial circles, and 30 percent were elected officials, representatives from union organizations, from various associations, etcetera...

Some 10,000 15 page documents, or a total of 150,000 pages, of grievances, of proposals and concrete suggestions, etcetera... were published on the occasion and at the conclusion of these conferences. They have given birth to a first series of 950 synthesis reports and 12 introductory reports, each about 50 pages long.

These 12 reports, which correspond to the 12 main themes of the national symposium, will form the basis for the debates, in committees and in plenary sessions.

The work of the symposium should in a way "enrich" the bill on the planning and orientation of research and technology, which has already largely taken into account the main ideas which have emerged during these conferences. They will be recorded in a nearly 2,000 page document, which will probably be published by Documentation Francaise.

The officials in charge of the symposium came up against a problem, among others, which was very delicate, the problem of participation in its activities. Eventually, the maximum that could be invited were some 1,200 representatives from the regions and from research bodies. Approximately 20 to 30 foreign scientists also received personal invitations, mostly from European and French speaking countries.

In conjunction with the symposium, an exhibition on the theme "Research and Technology: a Choice for the Future" was organized by the Maison de la Radio, where more than 100 demonstrations to transform the daily life of the French, were presented to the public. Finally, a "National Open Doors Day" at the laboratories is scheduled for 16 January, during which the scientific and industrial community is being mobilized to demonstrate, in about 100 laboratories, French research potential.

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TRANSPORTATION

SODIUM-SULPHUR BATTERY PROMISES FUTURE FOR ELECTRIC CARS

Heidelberg ELECTRISCHE ENERGIE-TECHNIK in German Nov 81 pp 11-12

[Article: "Hope Placed on Sodium and Sulphur"]

[Text] Apparently there is a deep-seated prejudice against the electric automobile due to its limited range. When batteries are compared to the gas tank on the basis of range and weight, the gas tank is clearly superior. But there are other considerations.

The average auto in the FRG is driven 14,000 km per year. If this distance is divided by the 250 working days per year, then the average per work day is 56 km. Using 365 days, the daily average is just under 39 km. Lead batteries are equal to this task right now (Figure 1).

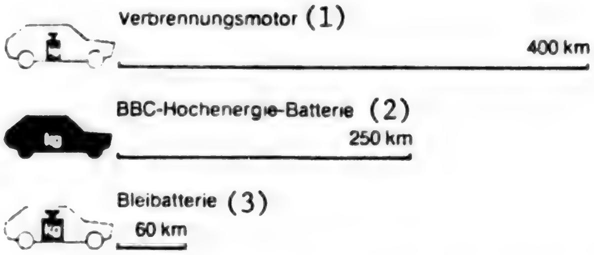

Figure 1: At the same total weight, an electric car with lead batteries can go 60 km; one with Na/S batteries 250 km; and the classical auto with internal combustion engine can go 400 km, but this range advantage is seldom used.

Key to Figure 1:

1. Internal combustion engine
2. BBC high-energy battery
3. Lead battery

Actually, it is reasonable to project that the concept of range will change in relation to the electric auto. In the case of the gasoline-powered auto, range is purchased at the filling station. For example, one may buy 20 liters--enough to go a certain distance or to last a certain number of days. For the electric car, range is bought up front in the form of batteries. This introduces a new yardstick. For the electric car, it pays to buy only what is really needed plus a margin of safety.

This emphasizes the fact that the electric car is a short-range vehicle. Present transportation figures show that 82 percent of all trips are less than 20 km and 90 percent are equal to or less than 50 km.

The criticism of the present electric car is nonetheless justified. Even its proponents are not satisfied with the performance of lead batteries, even though they result in practical, useable vehicles. The lead battery has disadvantages: It is too heavy, having low energy density; it is too expensive and, moreover, lead supplies are limited. There is only enough to last for about 30 years. Thus, the move away from oil will not be led by lead.

Worldwide, engineers are looking for new solutions. New laboratory models are presented at regular intervals. But this usually does not mean a great deal since between thelaboratory model and daily use lies the difficult technical-development phase which also includes the production process. Many good ideas run aground during this phase.

Only one new battery has reached production maturity: the sodium-sulphur battery. A small pilot production facility in Heidelberg is producing these energy storage units brought to maturity by BBC. The battery may achieve practical importance within a few years (Figure 2). Sodium and sulphur are cheap and abundant. Sodium (Na) is present in common salt; sulphur (S) generally occurs in combination with iron as iron pyrite or marcasite. Batteries made of Na and S are, to be sure, of unusual construction. Conventional batteries consist of two solid materials--zinc and pyrolusite in the case of flashlight batteries--separated by a liquid electrolyte. The Na/S battery has a solid electrolyte, namely a special type of clay, while the sodium and sulphur must be in liquid form. This means that the battery operates only at high temperatures--in the range from 300 to 350 deg C, to be exact.

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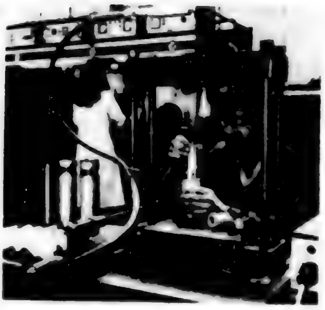


Figure 2: Production of the electrolyte tube for Na/S cells at BBC in Heidelberg. An aluminum oxide spacer ring is being mounted on a tube.

Figure 3: Assembly of a Na/S cell; at 2.1 V its terminal voltage is slightly above that of the lead battery.

The individual cells consist of the alumina container in the shape of a test tube which holds the sodium and which is surrounded by sulfur (Figures 3 and 4). Sodium ions migrate through the alumina container and leave behind free electrons. Outside they receive electrons from the sulphur, forming sodium sulfide. The process produces an excess of electrons in the alumina container and a deficiency of electrons outside the container. The charge is neutralized as electrons flow from the sodium to the sulphur through the external circuit of the electric car.

The process is reversible. If an electric current is sent through the cell in the reverse direction, it decomposes the sodium sulfide. The sodium ions migrate back through the tube, take on electrons and again become sodium atoms. This charge/discharge process can be repeated at least 1,000 times; British experts hope even 2,000 times. This means that the Na/S battery has an unusually long life.

4 Aufbau einer Zelle des Na/S-Akkumulators. Beliebig viele solcher Zellen können zusammengeschaltet werden

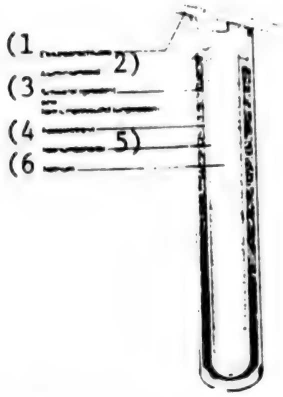


Figure 4: Construction of a Na/S-battery cell. Any number of such cells can be connected together.

Key to Figure 4:

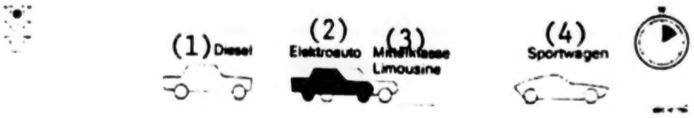
1. Terminals
2. Aluminum oxide
3. Sulphur (charged) or sodium polysulfide (discharged)
4. Solid electrolyte
5. Sodium container
6. Sodium

Neglecting the operating temperature aspect, the Na/S battery offers nothing but advantages compared to the lead battery:

--30 to 50 percent cheaper,
--About 10 percent higher charge/discharge cycle efficiency,
--4 times as much energy storage per unit mass,
--Non self-discharging,
--Nongasing,
--Twice the life, and
--Power to weight ratio of 100 W/kg compared to 60 W/kg, thus capable of driving a higher-powered motor for the same battery weight.

The high operating temperature is not necessarily a disadvantage. It requires very good insulation so that the electric car can be parked unused for several days without the battery having to be reheated. The insulator acts as a shock absorber which protects the battery from damage during an accident.

With the weight of a tank of gasoline which provides a range of 400 km for a medium-sized auto, the Na/S battery provides a range of 250 km. It can drive a 40-kW motor which achieves 130 km/h and accelerates the vehicle from standstill to 50 km/h in 7 seconds (Figure 5).



5 Elektroautos mit Na/Batterien beschleunigen in 7 s auf 50 km/h und übertreffen damit den Pkw mit Dieselmotor (Bilder: BBC)

Figure 5: Electric cars with Na/S batteries accelerate to 50 km/h in 7 seconds, out performing diesel-powered automobiles.

Key to Figure 5:

1. Diesel
2. Electric car
3. Medium-sized passenger car
4. Sports car

This performance about equals that of a medium-sized auto with a gasoline engine, but the electric car would have the advantage of a much longer life. The battery lasts for 200,000 to 250,000 km. The life of the electric motor and the electronics is even longer; thus, electric cars would have a long life; and, without question, they would preserve the environment. For, while a normal gasoline-driven auto discharges 40 g of pollutants into the atmosphere for each km, the electric car discharges only 3 g thanks to the central energy production in power plants. This figure applies, of course, to fossil-fueled power plants: Other types of power plant reduce air pollution even further.

It may be that the Na/S battery will not gain a foothold through the electric car; however, according to the developer, it is competitive today with the most efficient power plants, and it would without doubt lower the cost of wind-power plants. If such expectations are fulfilled, the future of the Na/S battery will be assured.

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TRANSPORTATION

RESEARCH WORK IN ADVANCED AUTO DESIGN REVIEWED

Bonn DIE WELT in German 16 Jan 82 p 17

[Article by Heinz Horrmann: "Research Vehicles: Technology for Production Tomorrow"]

[Text] Naturally, there were overtones of admiration but scepticism predominated. Cars of the future or research vehicles were always dismissed as "dream cars" at the time they were presented because they were nowhere close to production status and never had a chance of being built in that form. That was the case for decades. There has been a radical change with the newest generation of engineers' studies for the year 2000 and beyond. It makes no difference whether one considers the "cars of tomorrow" from the three German companies Daimler-Bens, Volkswagen and Audi NSU, which were built with government funds from the project "Auto 2000" or the studies from Citroen, Renault (with money from the French government), the Ford "Probe III" or Opel's "Tech I." All of them look very futuristic and winningly aerodynamic, but equally "suitable for the road." That is particularly true of the "Uni-Car," the remarkable car of the future developed by four technical universities, the fourth prototype being built with a German research grant. In its shape, the Uni-Car bears a slight resemblance to the VW "Auto 2000." However, the university work group placed special emphasis in the design of the bodywork on accident protection for pedestrians and bicyclists. The front of the car has a 5-centimeter-thick section of foam over the metal to prevent injuries in an accident.

In contrast to the cars from the manufacturers, the university study was not given its own engine. Instead, a Citroen 4-cylinder diesel engine was modified. Thanks to the excellent aerodynamics (C_d less than 0.30), the university planners believe a top speed of 190 km/hour can be reached without great power and a fuel consumption of 6.5 liters/100 km (combined cycle) can be achieved.

If only external appearance is taken as the criterion, the university research vehicle is not nearly as spectacular as the "competitors" from the car companies. Citroen took the biggest step forward with its "Styling Exercise" for a low-built coupe. In this car of the future, the driver's seat is in the middle, all the controls are grouped around the steering wheel and the passengers sit to the left and right of the driver.

German companies also achieved C_d figures below 0.30 with their prototypes, but otherwise they remained more conservative--both in overall design and as far as the engine is concerned. In their research work, Audi, Mercedes and VW skillfully avoided competing with each other. Daimler-Benz--what else was to be expected--built the comfortable long-distance sedan for the year 2000, 5.10 meters in length and weighing 1,600 kg. Two gas turbines of 128 horsepower, a turbocharged 6-cylinder diesel engine and a conventional V-8 gasoline engine are planned as possible power plants. Fuel consumption is said to be 6.7 liters/100 km (at 120 km/hour) with the turbine and 7.5 liters/100 km with the diesel.

The Volkswagen engineers in Wolfsburg were intent on building an extremely small and light vehicle. The tiny aerodynamic car is driven by a 45-horsepower, 3-cylinder turbocharged diesel engine. Consumption is said to have breen brought down to 4 liters/100 km.

Audi NSU concentrated on a middle-class automobile. The 4.8-meter-long car, designed as an ideal vehicle for a family of four, was given styling that would scarcely be out of place in traffic today.

Under a contract from the French Ministry of Energy, Renault developed the EVE (Economy Vehicle Elements) research vehicle with exactly the same "family plan." The highly elegant sedan achieves a coefficient of drag of 0.23 in the wind tunnel without any visible aerodynamic aids. That means a fuel consumption 30 percent less than the R 18.

The external shape of Opel's research project was derived with the aid of computers. All-round glass is joined flush to the bodywork. The glass also covers the roof pillars and prevents air turbulence along the sides. Only a detail, but such meticulous aerodynamics, which is also evident in the full-length underbody pan, helps the car achieve exemplary economy and better usability in everyday driving.

Ford's "Probe III" gives the strongest impression of being close to production. Although many new engineering ideas for the future were released, equal attention was given to a high degree of functionality and careful detail. A prominent double spoiler on the tailgate not only resulted in better airflow but also made it possible to keep the rear glass clean. What still seemed like a pipe dream when the advanced Ford study was first shown is already standard in the successor to the Taunus, which will be introduced in September. The "Sierra" is nothing more than a slightly altered "Probe III" car of the future.

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